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**MILITARY COST ANALYSIS IN THE FCRCs (FEDERAL CONTRACT
RESEARCH CENTERS) - 1950-1975**

James D. McCullough

**Institute for Defense Analyses
Arlington, Virginia**

October 1975

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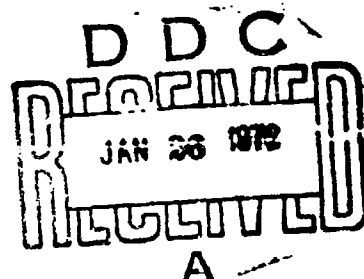
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**INSTITUTE FOR DEFENSE ANALYSES
COST ANALYSIS GROUP**

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21. ABSTRACT (Continue on reverse side if necessary and identify by block number) The 16 organizations which were Federal Contract Research Centers (FCRCs) in 1969 are identified. The current list of 9, including the 4 which have Cost Analysis Groups (CAGs), is described by OSD category. "CAG" is defined in terms of organizational structure and functions. The history and staffing of CAGs in the 7 FCRCs (of the 16) which have had CAGs is traced from the inception of the RAND Corporation's CAG in		

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1950 through 1975. The role and contributions of the CAGs during three time periods—the 1950-60 period, the Hitch-McNamara period of 1961-67, and the 1968-75 period—are discussed.

Negative views by some members of Congress and the uniformed military of the FCRCs are analyzed as to possible causes and as to their impact on the FCRCs. The recent impact of this changing environment on CAGs is discussed.

The results of an informal survey of the 4 CAGs is presented, including their organizational title, management, staff size, military clients, and planned military research program for FY 76.

Finally, some thoughts on the future of the CAGs and some suggestions for utilization of their staffs are presented.

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400 Army-Navy Drive, Arlington, Virginia 22202**

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FOREWORD

This paper reviews the past contributions of Cost Analysis Groups in Federal Contract Research Centers to the field of cost analysis in the Department of Defense (DoD), presents the results of an informal survey of their current status, and suggests some actions by DoD which may improve their future contributions.

This paper was written to provide background information and to stimulate discussion in a seminar on "Cost Analysis-- Its Role in DoD" held at the Tenth Annual DoD Cost Analysis Symposium, October 14-17, 1975, at Airlie House, Warrenton, Virginia.

This paper will examine the role and contribution--past present, and future--of the Cost Analysis Groups (CAGs) in the Federal Contract Research Centers (FCRCs) to the field of cost analysis in the DoD.¹ After defining key terms, the history and staffing of the CAGs over the past twenty-five years will be reviewed; their role and contributions during three time periods--the 1950-60 period, the Hitch-McNamara period of 1961-67, and the 1968-75 period--will be discussed; the results of an informal survey of current CAG organizations, clients, and research programs will be presented; several problem areas facing the CAGs will be identified; and an assessment of the future situation will be made, as well as suggestion of some DoD actions which may improve CAG future contributions. Although information has been obtained from the manager of each CAG, the views expressed herein are solely the author's and do not necessarily represent those of any other CAG managers, or of the respective corporations.

¹The author takes for granted that the reader appreciates the importance of cost analysis, and its product--cost estimates--to the DoD decision-making process. Cost estimates play an important role in most major DoD decisions, from weapon system design and choice, to force-mix decision, to policy decisions on the support base (training, medical, supply and maintenance, etc.). Defense planning will be thrown out of kilter to the extent that cost estimates are not accurate. In Charles Hitch's words "Strategy, technology and economy are not three independent "considerations" to be assigned appropriate weights, but interdependent elements of the same problem....Strategy and cost are as interdependent as the front and rear sights of a rifle." Charles J. Hitch and Roland N. McKean, *The Economics of Defense in the Nuclear Age*, (Cambridge: Harvard Univ. Press, 1960), p. 3.

A. DEFINITIONS

To set the stage for the remaining discussion, "FCRC" and "Cost Analysis Group" are defined, as used in this paper.

1. FCRC

FCRC refers to the special group of nine nonprofit institutions identified by Dr. Malcolm R. Currie in his testimony to the 94th Congress.¹ He described their role in the DoD RDT&E program and their characteristics as follows:

"We rely on the FCRCs for analyses and evaluations to assist in our planning, for system engineering and technical direction on many of our systems, and for research and technology development. While there is not a clearly defined distinction between FCRCs and other nonprofits, FCRCs tend to have the following characteristics.

- They exist primarily to perform work for the Department of Defense.
- They have no commercial affiliations and undertake little or no work for private industry.
- They are usually funded by sole-source, annual contracts which implies a DoD attitude of responsibility for their continuance and stability.
- They have continuous privileged access to data of the government and industry in their fields of work (in exchange for which they accept stringent limitations upon their scope of activities and range of customers)."

DoD classifies the FCRCs into three categories--System Engineering and Technical Direction Institutions, Studies and Analyses Institutions, and Laboratory Institutions--as shown on the following table (compiled from Currie's statement) of their professional and support staffs that are working on DoD contracts.

¹"Program of Research, Development, Test and Evaluation, FY 1976," Statement by the Director of Defense Research and Engineering to the 94th Congress, 1st sess., February 26, 1975, pp. IV-35 - IV-44.

Table 1. FCRC PROFESSIONAL AND SUPPORT STAFF -
DOD EFFORT ONLY
(February 1975)

<u>System Engineering and Technical Direction Institutions</u>	
The MITRE Corporation (MITRE)	1400
The Aerospace Corporation (Aerospace)	2200
<u>Studies and Analyses Institutions</u>	
The RAND Corporation (RAND)	550
The Institute for Defense Analyses (IDA)	350
Analytic Services, Inc. (ANSER)	85
The Center for Naval Analyses (CNA)	360
<u>Laboratory Institutions</u>	
MIT Lincoln Laboratory	1700
The Applied Physics Laboratory (Johns Hopkins University)	2110
The Applied Research Laboratory (Pennsylvania State University)	330
TOTAL	9085

While an historical analysis of the development of FCRCs is beyond the scope of this paper, it should be noted that the number of FCRCs has decreased in recent years. For example, there were 16 FCRCs included in the FY-69 budget¹ and 12 in the FY-72 budget.² The four dropped from the FCRC list by FY-72 were:

- Mathematics Research Center, University of Wisconsin
- Center for Research in Social Systems, American University
- Hudson Laboratory, Columbia University
- Illinois Institute of Technology, Research Institute.

¹Senate Foreign Relations Committee Hearing, May 21, 1968.

²John Maffre, "Defense Report/Congress Presses Pentagon to Phase Out "Think Tanks," Shift Emphasis to In-House R and D," *National Journal*, (November-December 1971), p. 2426.

The three dropped from the FCRC list by 1975 were:

- Applied Physics Laboratory, University of Washington
- Human Resources Research Organization (HUMRRO)
- Research Analyses Corporation (RAC)

Of the above, only RAC, a Studies and Analyses Institution (S&A), had a CAG, and is included in this review.

2. Cost Analysis Group

Cost Analysis Group refers to (1) a "Group" that (2) conducts "Cost Analysis." Group refers to an organizational unit that has the conduct of military cost analysis as one of its official missions. Military refers to research sponsored by OSD agencies or by the Military Services, thus, research for NASA or other civilian agencies is excluded.

By requiring that an FCRC have an organizational unit officially charged with the conduct of cost analysis, two categories of estimators are eliminated from further consideration in this paper--those qualified military cost analysts who happen to be on the staff of an FCRC but who are not part of a CAG (as currently may be found at the Aerospace Corporation, for example), and the hundreds of individuals who make cost estimates as part of some other activity, such as do the project engineers in the Laboratory FCRCs and the Systems Engineering FCRCs.

Cost Analysis refers to the broad spectrum of activities conducted by the CAG professional staffs, ranging from research on acquisition policies, such as the Design-to-Cost concept, to the support of systems analysis studies. The latter activity is the primary role of cost analysts in the Studies and Analyses Institutions. This role is succinctly described by Fisher as "...assessing the economic cost implications of proposed alternative future courses of action under conditions of

uncertainty."¹ This role requires such activities as the systematic collection and analysis of Life Cycle Cost (LCC) data, the development of Cost Estimating Relationships (CERs), and the development of cost models.

B. COST ANALYSIS ORGANIZATIONS IN THE FCRCs

Of the nine FCRCs, five currently do not have CAGs in their organizational structure:

- MIT Lincoln Laboratory
- Applied Physics Laboratory
- Applied Research Laboratory
- Analytic Services, Inc.
- The Aerospace Corporation.

The three laboratories have never had a CAG to the author's knowledge. The CAGs of Analytic Services, Inc., and The Aerospace Corporation were phased out in 1968 and 1974, respectively, as will be discussed in Section C.

The four FCRCs which currently do have a CAG, and on which this paper focuses, are listed below, together with the number of CAG professionals.

Table 2. FCRC STAFFING

FCRC	CAG Professional Staff ^a
The MITRE Corporation	17
The RAND Corporation	15
The Institute for Defense Analyses	13
The Center for Naval Analyses	<u>10</u>
TOTAL	55

^aExcluding research assistants, technical aides, and support staff.

¹Gene H. Fisher, "Cost Considerations in Systems Analysis," (New York: American Elsevier Publishing Co., Inc., 1971), p. 98.

The FCRC staffing shown on Table 1, above, includes support staff. If the professional staff size of the CAGs is doubled to allow for company-wide support staff,¹ then CAGs comprise about six percent of the three S&A FCRCs staffs. MITRE has two major locations, with approximately 40 percent of its professional staff located at McLean, Virginia, working mostly on non-defense contracts, and 60 percent of its staff at Bedford, Massachusetts, working on defense contracts. The MITRE CAG is located at Bedford and comprises about four percent of the staff there.

C. CAGs IN THE FCRCs - A 25-YEAR PERSPECTIVE

Before examining the current status of these four CAGs, the past 25 years will be reviewed in order to provide a better perspective on the current situation. The author has been privileged to enjoy a personal acquaintance with most of the cost analysts in the FCRCs since joining RAND in late 1956, and has a strong personal interest in the organization, staffing, and research program of the CAGs.

Figure 1, an estimated staffing of the CAGs from 1950 to 1975, has been constructed from personal notes compiled over these many years. Seven FCRCs are charted, including the three CAGs which were phased out during this time (Aerospace, ANSER, and RAC). While there are a great many "hard" data points, occasionally the author interpolated between two such points; thus, the data points for individual CAGs are only approximate. The total trend line, however, is sufficiently accurate for our purposes.

Figure 1 depicts the estimated professional staff (excluding technical aides) of the CAGs who were working on military

¹ The Studies and Analyses FCRCs typically have about a 1:1 ratio of professional to support staff on a company-wide basis.

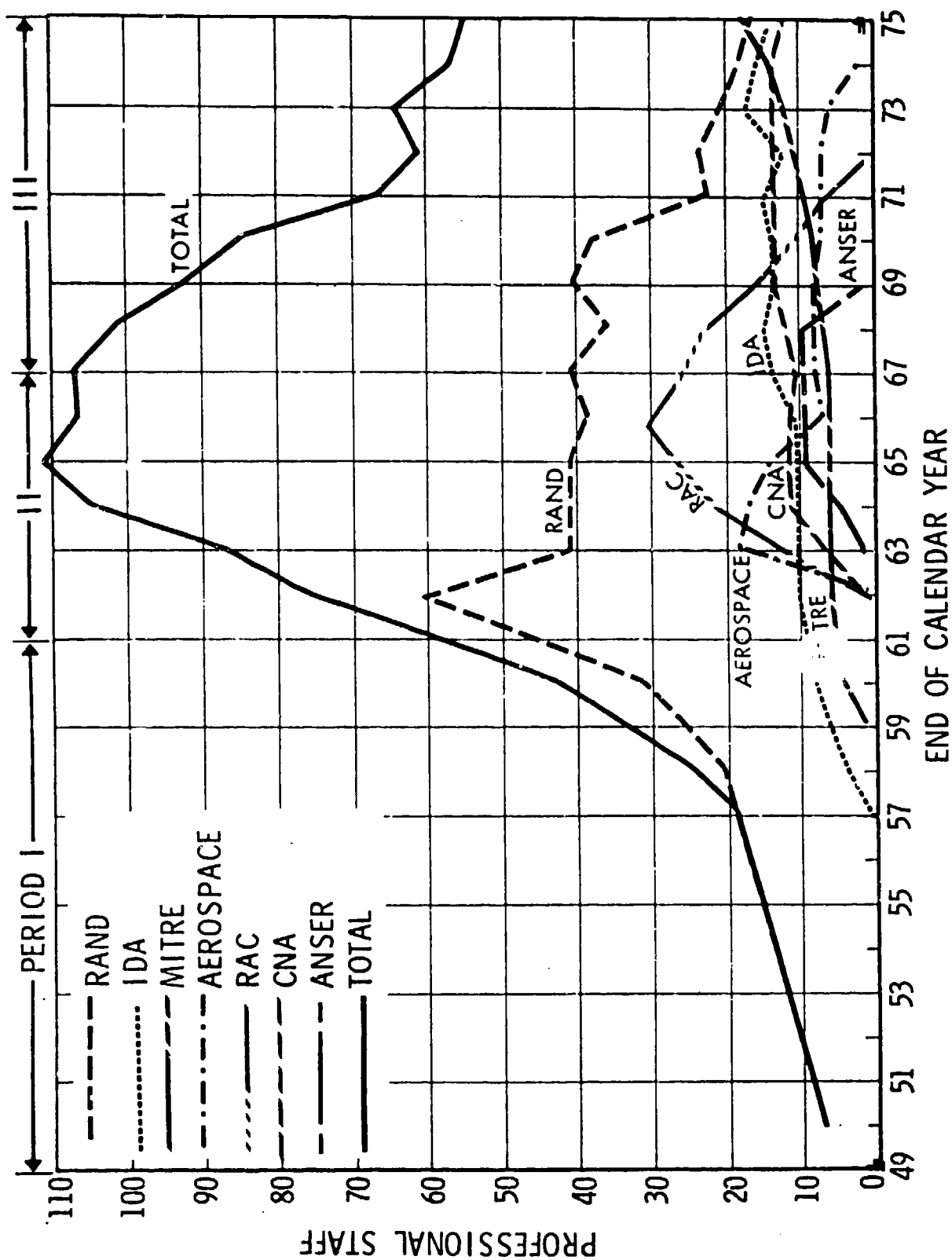


Figure 1. FCRC COST ANALYSIS GROUPS PROFESSIONAL STAFF--EXCLUDING TECHNICAL AIDES--ON MILITARY COST ANALYSIS TASKS 1950-75

cost analysis tasks during the 1950-75 time period. The quarter-century has been arbitrarily divided into three time periods to discuss the emerging patterns.

1. Period I -- 1950-60

This was the formative, creative period when many of the cost concepts and methodologies in use today were developed. The RAND Corporation pioneered the field, establishing a Cost Analysis Department under the leadership of Mr. David Novick in February 1950. The department was given its own budget under the Project RAND contract with the Air Force, and initiated nearly all of its research program. ("Project Management," with its attendant effects on functional architecture, did not hit RAND until the late 1960s. This subject will be covered in more depth later.) Toward the end of this period, IDA and MITRE began the development of CAGs. Dr. E. D. Brunner started a CAG at IDA as a sub-department of a larger department working with the Weapons Systems Evaluation Group. In July 1960, following the Winter Study Group (WSG) hosted by MITRE for the Air Force Command and Control Development Division (now designated as The Electronics Systems Division) to evaluate command, control, and communication systems, the MITRE members of the WSG Cost Panel formed a CAG as part of a Systems Analysis Department under Dr. Norman Waks.¹

The contributions of the FCRC CAG's to the field of cost analysis in the DoD were significant during this period. The emphasis was on methodology and included:

- (1) The Weapon Systems Cost concept--the identification of all resources required over a system's

¹The author was Chairman of the WSG Cost Panel. Dr. Waks is now MITRE's Corporate Chief Management Scientist.

life cycle (as distinguished from just identifying the "hardware" costs).¹

- (2) Total Force Structure Cost Methodologies-- methods and computerized models for estimating the support structure of a Service, as well as the weapon systems--permitting estimates to be made for alternative total force structures of a Service.²
- (3) Program Planning and Budgeting (PPB) System-- derived from the Weapon System and Force Structure Cost Methodologies and which extended the DoD planning horizons from one year to five, bridged the gap between long-range planning and annual budgeting, and institutionalized "Systems Analysis."³

2. Period II -- 1961-67, "The Hitch-McNamara Era"

This period was one of almost explosive growth for the FCRC CAGs as the PPB System was implemented and, with it, a requirement for the Services to conduct cost-effectiveness studies.⁴ The RAND Corporation was instrumental in implementing the PPB System. RAND established a 25-man office under Dr. Robert N. Grosse in Bethesda, Maryland, during 1961-62

¹Publication naturally lagged behind development of the methodologies. Early examples include the following, as well as footnotes 2 and 3:

David Novick, *Weapon-System Cost Methodology*, The RAND Corporation, R-287, February 1, 1956.

²David Novick, *System and Total Force Cost Analysis*, The RAND Corporation, RM-2695, April 15, 1961.

³David Novick, *Efficiency and Economy in Government Through New Budgeting and Accounting Procedures*, The RAND Corporation, R-254, February 1, 1954, and Charles J. Hitch and Roland N. McKean, *The Economics of Defense in the Nuclear Age*, (Cambridge: Harvard Univ. Press, 1960).

⁴"Cost-effectiveness studies" was the prevalent term in the early 1960s. Later, "systems analysis studies" became the preferred term. "Systematic analysis" and "policy analysis" are terms gaining popularity today. All terms essentially refer to the quantitative and qualitative analysis of the costs and benefits of proposed alternative courses of action. For an attempt at differentiation of these terms, see E. S. Quade, *Analysis for Public Decisions*, (New York: American Elsevier Publishing Company, Inc., 1975), Chapter 2.

to assist Assistant Secretary of Defense (Comptroller) Charles J. Hitch in designing and implementing the PPB System.¹ Aerospace, ANSER, RAC, and CNA all established CAGs during this time to participate in the conduct of cost-effectiveness studies. The Aerospace Corporation formed two CAGs in 1963--one, at El Segundo, California, under the leadership of Dr. Marvin Hoffenberg, and one at San Bernardino, California, under Mr. Floyd Erickson. In 1966, when the Air Force consolidated the Space Division and the Ballistic Missiles Division of AFSC into "SAMSO," the two CAGs were combined into a single unit at El Segundo, with Erickson heading it. The Analytic Services Corporation formed a CAG under the leadership of Dr. Edward Goretsky in 1964. In 1963, Dr. Grosse joined the Research Analysis Corporation and formed the Economics and Cost Division. Another CAG was formed in 1963 when Mr. Joseph W. Noah left RAND to join the Center for Naval Analyses and form a Resource Analysis Division. In 1967, IDA, which, by then, had added a small number of cost analysts outside the WSEG group, centralized its cost analysis efforts in a Cost Analysis Group, under the direction of Dr. Harry Williams.²

The FCRC CAGs were also involved, to various degrees during this time, in assisting the Services in the development of an organic cost analysis capability--an important development for cost analysis in the DoD. For example, RAND, which had maintained an office in Bethesda, Maryland, during 1961-62 to assist OSD, continued the office from 1963-68 to assist the Air Force in establishing a CAG in the Directorate of the Budget, Hq. USAF. (The CAG is now in the Directorate of Management Analysis.) On-the-job training was provided to

¹The author was Deputy Director of the RAND-Bethesda facility during this time.

²The author was Deputy Director of the IDA Cost Analysis Group from its inception in February 1967 until February 1968, when he became Director.

Air Force officers and civilians during this period.¹ The contractual level-of-effort at Bethesda was substantially reduced from the 1961 level, but additional support was provided by RAND, Santa Monica. In addition, RAND, Santa Monica, provided assistance to the Air Force while CAGs were being formed at Hq. AFSC and at the AFSC Divisions. Mr. Brent D. Bradley, Dr. Gene H. Fisher, Mr. Milton A. Margolis, and Mr. David Novick made substantial contributions to this effort.

RAC's CAG provided support to the Army Cost Analysis Program during the 1963-74 time period, especially during the period when Dr. T. Arthur Smith was Chief, Cost Analysis, Comptroller of the Army.²

In sum, the contributions of the FCRCs during this period were significant--but the emphasis was on implementation rather than on methodology (although a number of important CERs were published by FCRCs).³ The key implementation actions were:

- (1) PPB System development and implementation⁴
- (2) Support of systems analysis studies in the seven FCRCs
- (3) Assistance in the establishment of CAGs in the Services.

¹The author was Director of the RAND-Bethesda facility from 1963 to February 1967.

²For an example of RAC support, see Alfred D. Stament and Carl R. Wilborn, *Cost Estimating Relationships: A Manual for the Army Materiel Command*, RAC TP-449, May 1972.

³For example, A. F. Watts, *Aircraft Turbine Engines: Development and Procurement Cost*, The RAND Corporation, RM-4670-PR, November 1965. Also a significant contribution in conceptual methodology to treat cost uncertainty was S. A. Sobel, *A Computerized Technique to Express Uncertainty in Advanced System Cost Estimates*, The MITRE Corporation, TM-3728, September 1963.

⁴For a brief history, see David Novick (ed.), *Program Budgeting*, The RAND Corporation, 1964, Chapter 3.

3. Period III - 1968-75

The situation of the FCRC CAGs underwent a significant change during this period. The concepts and methods developed in Period I had been implemented in Period II. The Services and OSD had built up a substantial organic cost analysis capability. The FCRC CAGs therefore turned to the support of systems analysis studies in their own organizations as their primary role.

One might have expected a limited reduction in the staffing of the CAGs as the implementation activity ended, and a return to the former emphasis on *functional* cost analysis research. However, a number of factors were at work to significantly change the environment of the FCRCs, and, consequently, their CAGs. The end result during this period was a significant reduction in both the number of CAGs and in their staffs, and severe constraints on the amount of self-initiated functional research that could be undertaken.

Some of the factors contributing to the changed environment are described in the following paragraphs.

Negative views were taken of the FCRCs, especially the "think tanks," by some members of Congress and the uniformed military. There is a long history associated with the development of such negative viewpoints and it is beyond the scope of this paper to present that history.¹ However, items cited (whether valid or not) include:

- (1) The use of FCRCs as a device to pay salaries higher than that paid the Civil Service.
- (2) The use of FCRCs to avoid personnel ceilings imposed on sponsoring agencies.

¹For some early discussions of the problems, see James D. Grant, "The Future of Nonprofit Research and Development Organizations," *California Management Review*, Summer 1965; and Bruce L. R. Smith, *The Future of the Not-For-Profit Corporations*, The RAND Corporation, P-3366, May 1966.

- (3) Unfair competition by FCRCs with profit-making companies.
- (4) The view that FCRCs actually made DoD policy and, by implication, helped involve the United States in the Vietnam War.
- (5) Management practices that might have been acceptable in industry but were questioned for organizations viewed as quasi-public in character, such as the much-publicized shipment of the boat belonging to the president of Aerospace Corporation from New England to California.

With regard to the recent past, possible additional contributions to such a viewpoint include the release of the so-called "Pentagon Papers" by Daniel Ellsberg of The RAND Corporation to the New York Times and the Washington Post in June 1971; the belief that FCRCs were feeding information to systems analysts in OSD which was being used to make decisions unfavorable to the Services; and the military backlash against studies and analyses, in general, following the departure of Hitch and McNamara.

Whatever the causes, the actions taken against the FCRCs included:

- (1) The imposition by Congress of dollar ceilings for DoD funds on the FCRCs. This action, imposed in late 1971 when Congress passed the FY-72 budget, was accompanied by cuts of up to 25 percent of the budget of the "think tanks." Congress announced a "no-growth" policy for the FCRCs as a whole and manpower ceilings were placed on the "think tanks" (Studies and Analyses FCRCs).¹
- (2) The establishment by the Director, Defense Research and Engineering, of a review committee or office, generally termed a

¹August 11, 1972, memorandum from Dr. John S. Foster, Jr. to the Secretaries of the Military Departments, Assistant Secretaries of Defense, and Directors of Defense Agencies. Dr. Foster advised that DDR&E had made a commitment to the Congress to "...hold the total DoD effort at the Study and Analysis Centers constant for the next three fiscal years, using 30 June 1972 targeted personnel levels as the baseline."

"Users Group," for each of the Studies and Analyses FCRCs (RAND has two, one for the Air Force contract and one for the OSD contract). The Users Group reviews proposed tasks to see if they are "appropriate" for the FCRC and allocates ceiling money for tasks which they approve.¹

As an example, "appropriateness"² as defined by the Joint Users Group established for IDA is as follows:

"c. The basic criteria to be used to determine what tasks will be approved are:

- (1) The task should be of such a nature that there will be an identifiable product, such as a report. Staff support/personnel services cannot be undertaken.
- (2) The task must bear on important issues that are to be addressed in the Department of Defense.
- (3) The task should be of such a nature that it would not be appropriate to have it conducted by private companies, either because of the sensitive nature of the task or because of lack of expertise."

IDA management has interpreted this last point as follows: This (sensitivity) includes potential or actual conflicts of interest in that there should be no connection with a defense or weapons system that leads to support of the contractor, if the contractor is to advise the DoD about the system.

A second contributory factor altering the environment of the FCRCs, and, consequently, their CAGs, was the shift from functional management to project management by the FCRC management as a basic means of assigning and controlling funds. Briefly, this arrangement assigns control of funds to projects (tasks) rather than to functional areas of research. Thus,

¹Ibid.

²Rear Admiral M. H. Sappington, "Memorandum for Members of Joint Users Group for Institute for Defense Analyses," (Subject: IDA Joint Users Work Program for FY 76), January 16, 1975, Enclosure 1.

the vast majority of the professional staff must be assigned to approved projects under Project Managers rather than to functional research programs initiated by the functional departments, such as CAGs. Project management varies in the degree of tightness of control in the FCRCs with CAGs. (The author believes it to be "tight" at MITRE, IDA, and Project RAND: less so at CNA and RAND-OSD.)

In any event, it is the author's observation that project management, regardless of its virtues, is a severe detriment to functional research, such as cost methodology research. Project managers are not interested in supporting research which does not have an immediate direct payoff for their project. Their point is well taken, but it means that CAG managers must find other means of funding cost research, primarily through obtaining their own "projects" from cost-oriented sponsors. In support of this observation, note that RAND, in announcing the establishment of an endowment fund for innovative research, had this to say:

"Although we have considerable license to suggest or reject research topics in our major contracts, the bulk of our contract funding is earmarked for specific lines of inquiry that reflect our sponsors' current perceptions of their research needs. This is understandable, but it restricts opportunity for innovative research that occupies too low a position in the client's list of priorities, or falls outside his purview of responsibility, or extends beyond the typically short-term focus of government, or simply transcends the concerns and responsibilities of any one agency of government. There is a lack, in other words, of "discretionary" funding that would enable Rand to initiate and carry forward research which, although it promises a significant payoff in new knowledge about public policy choices, would not find sponsorship within the existing patterns of government contracts and grants."¹

¹ The RAND Corporation, 27th Annual Report, 1974-75, p. v.

Pressures on the defense budget have also helped shift FCRC emphasis. Such factors as double-digit inflation, the greatly increased military pay and allowances resulting from the shift to a Volunteer Army, and needs to modernize the equipment of the Services have led to greatly increased DoD fund requirements. However, this has met substantial Congressional resistance. The result is a very tight defense budget. Two possible results of this situation are:

- (1) It keeps the pressure on the FCRC ceilings, with only a five percent increase per year permitted in recent years to accommodate inflation (under the "no-growth" policy). Unfortunately, the five percent rate has not kept pace with actual inflation, causing a slight decrease in FCRC staffs each year. (The Congressional ceiling was, in theory, supposed to provide for a stable manning of the FCRCs by an annual allowance for inflation.)
- (2) OSD and the Services have less money for studies and analyses. This seems especially so for cost analysis/resource analyses studies. Thus, the FCRC CAGs have a limited market for their external business, as opposed to the internal support of company studies.

Finally, some FCRCs have shifted their emphasis toward civil business. Within limits, FCRCs were encouraged by Secretary Laird to apply their expertise in assisting the civilian agencies of the Federal Government. Laird suggested a "civil" target of 20 percent of their total business.¹ Some FCRCs, either on their own initiative (e.g., RAND) or under the pressures of the (decreasing) Congressional ceiling for military business (e.g., RAC) chose to seek a much larger share of "civil" business. This trend was recognized by Dr. John S.

¹Ref. letter from Secretary of Defense Melvin R. Laird to the heads of major Federal agencies, March 4, 1969. The exact phrase was "We do not expect that the total annual non-DoD activity at any one FCRC would exceed more than approximately one-fifth of their total annual effort...."

Foster, DDR&E, as early as 1969, in his Congressional Testimony:¹

"Another significant factor which I have already mentioned is the increasing interest by several FCRC's in taking work from non-DoD agencies, both because this work is challenging, and because such work provides an opportunity for professional and corporate growth not possible with the funding available during the past five years. Such "diversification" holds the promise, as I mentioned earlier, of helping the country solve some of its urgent domestic problems. But the process of diversification could lead to management of some FCRC's to consider moving out of the sponsored status and becoming an independent profit or nonprofit group. The choice, thus, is not entirely ours."

Results of such policies, in my personal opinion, include:

- (1) A shift of experienced analysts from military to civil business
- (2) Less interest in seeking military research tasks, including those for cost analysis.

CAGs at three FCRCs were phased out during this period. ANSER phased out its CAG in July 1968 following a policy dispute with the Air Staff over whether its cost estimate for a major weapon system would be substituted for a lower one received from AFSC. *Independent Estimates* were not being stressed then as much as now, given the operation of the CAIG,² and the Air Staff not only rejected the ANSER estimate but (according to the author's informal discussions with former ANSER cost analysts), persuaded ANSER to phase out their CAG

¹"On the Fiscal Year 1970 Defense Research, Development, Test and Evaluation Program" Statement by the Director of Defense Research and Engineering, Dr. John S. Foster, Jr., before the Committee on the Armed Services, U.S. Congress, House, April 30, 1969, p. 6-25.

²"OSD Cost Analysis Improvement Group," DoD Directive 5000.4, June 13, 1973.

to avoid similar situations! Aerospace phased out its CAG in late 1974 following a Congressional budget cut. With regard to RAC, the DoD policy for FCRCs, developed in response to the 1971 Congressional concerns, removed RAC from the list of DoD-sponsored FCRCs.¹ On September 1, 1972, RAC became the Operations Analysis Division of the General Research Corporation.

In sum, the primary contribution of the FCRC CAGs during this period was the internal support of systems analysis studies of the FCRCs. A notable exception to this was the development by CNA of the Navy Resource Model (NARM), which is now in daily use by the Navy (OP904) in its on-line PPBS activity. The computerized model permits rapid estimation of the direct and indirect operating costs of Navy force structures.²

D. THE CURRENT STATUS OF THE CAGs

A recent survey was conducted of the current status of the four FCRC CAGs. A brief description of their organizational title, missions, leadership, staff size, military clients, and planned military research program for FY-76 follows (excluding non-military work and staff associated thereto). The research program description is necessarily brief, given the purpose and scope of this paper.³ It has been classified into *methodology* (covering the development of concepts, models, data, or CERs) and *application* (covering the application of existing techniques to specific projects). The allocation is arbitrary, but approximately correct. Following the research program description is a discussion of the current climate in which the CAGs operate. The author is indebted to a reviewer of this paper

¹Foster, August 11, 1972, memorandum, *Op. Cit.*

²Joseph Augusta, *Report on the Navy Resource Study to the Advisory Committee*, Institute for Naval Studies (CNA), 1787-73, October 1973.

³The author apologizes to the FCRC CAG heads if the full extent and nature of their research programs have not been adequately conveyed.

for bringing attention to a key, but unstated bias of mine, namely the stress on methodology. I place great importance on research on methodology because this is in the capital investment which will permit us to do better studies in the future. Methodology is further divided into two types (and this, again, is the author's view): that which utilizes current tools and techniques to provide better data, factors, CERs, and cost models; and that which is oriented toward the development of new approaches to cost analysis. As to the first type, everyone recognizes the extensive resources and the time required to gather, normalize and analyze data in order to develop useful factors or CERs. Yet, finding analysts who are free to do this, and keeping them free is very difficult. The result is that most systems analysis studies supported by the cost analysts (DoD-wide, not just in the FCRCs) must use *ad hoc* approaches to getting the job done. Sometimes this is satisfactory and time is found to develop credible CERs; quite often, however, estimates must be made in a haphazard manner or taken, unchallenged, from other sources.

The quality of current systems analysis studies will gradually decline if not supported by an adequate research base. As to the second type, in my view, the DoD cost analysis community has nearly exhausted the intellectual capital created during the early 1950s. We need a small but elite team of top analysts to be freed from fire-fighting to seek new methodologies.

1. Organization, Staffing, and Research Program

The MITRE Corporation has a Resources Management Department under Mr. Eugene D. Lundberg. One of the department's missions is cost analysis; approximately 17 cost analysts (plus seven technical aides) work on military cost analysis projects under the direct leadership of Mr. Jack M. Hockett, Associate Department Head. About 80 percent of the effort is for the Air Force, and about 10 percent each is for the Army and Navy,

respectively. (The research program at MITRE is oriented toward the *acquisition* phase of systems while that of the S&A FCRCs is oriented more toward the *conceptual* phase.) The planned research program for FY-76 includes tasks on:

MAN-YEARS

a. Methodology

(1) <u>Life Cycle Costs/Design to Cost</u>	3
Guidelines to SPOs were recently developed in a handbook on LCC/DTC. ¹ This year, several on-going programs will be selected for a test of the applications of these guides.	
(2) Cost Models - Electronics and C ³ Systems ²	4
(3) Strategies for Acquisition of Systems-- Contract Incentives for Reliability, etc.	
TOTAL	7

b. Application

(1) Interoperability of C ³ Systems	2
(2) AFSATCOM Operating and Support Costs	2
(3) Army C ³ Program	1
(4) Navy Telecommunication Architecture	2
(5) Air Force C ³ Programs Cost Analysis	3
TOTAL	10
GRAND TOTAL	17

The RAND Corporation has a Management Sciences Department headed by Dr. Gene H. Fisher. One of the department's missions is resource analysis; approximately 15 cost analysts work on military cost analysis projects under the direct leadership of

¹J. M. Hockett, et. al., *Life Cycle Cost/Design-to-Cost Guidelines*, The MITRE Corporation, M75-216, June 30, 1975; M. P. Galin, S. Merecki, and A.E. Schutzman, *Life Cycle Cost/Design-to-Cost Planning, Applications and Methods*, The MITRE Corporation, MTR-3032, June 1975.

²C³ = Command, Control and Communications.

Mr. Brent D. Bradley, Associate Department Head. About 75 percent of the effort is for the Air Force and about 25 percent for OSD agencies (DARPA, OASD-PA&E, and OASD-ISA). The planned research program for FY-76 includes tasks on:

MAN-YEARS

a. Methodology

(1) "FORCE" - An Air Force force structure costing model which emphasizes support cost relationships	3
(2) Cost Implications of Aircraft Simulators	4
(3) Life Cycle Cost Analysis	
(4) CERS for High Cost Avionics	
(5) CERS for Standoff Missiles	
(6) Air Force Officer Cost Model	
(7) Aircraft Spares Requirements Cost Model	7
TOTAL	

b. Application

Support of Systems Analysis Studies:

(1) Standoff Missiles	8
(2) Reserve and Guard Forces	
(3) Defense of Air Bases	
(4) Other Strategic and Tactical Weapon System Studies	
(5) Implications of Automotive Diagnostics for Army Vehicular Maintenance	
TOTAL	8

GRAND TOTAL 15

The Institute for Defense Analyses has a Cost Analysis Group under the author's direction. The group's primary mission is military cost analysis; approximately 13 cost analysts work on military cost analysis problems. All of the effort is for OSD agencies, of which about 45 percent is for WSEG/JCS, 25 percent for DARPA and DDR&E, and 30 percent for OASD-PA&E. The planned research program for FY-76 includes tasks on:

MAN-YEARS

a. Methodology

(1) Navy FYDP Redesign

Development of a new FYDP structure which identifies all direct and indirect logistics costs

4

(2) Design to Cost-Reliability Improvement Warranties

Research of the experience-to-date with application of RIW on contracts having a DTC goal¹

2

TOTAL

6

b. Application

Support of Systems Analysis Studies of Strategic and Tactical Weapons, including:

(1) Air Defense Requirements²

3

(2) Strategic Offensive Force Mixes

1

(3) Zero CEP Weapons Systems

1

(4) Strategic Bombers in Tactical Roles

1

(5) Force Readiness Measures

1

TOTAL

7

GRAND TOTAL

13

The Center for Naval Analyses has a Resource Analysis Division headed by Dr. Joseph H. Augusta. One of the Division's missions is cost analysis; approximately 10 cost analysts (plus six technical aides and three military officers) work on military cost analysis problems. All the research is for the Navy. Unlike the other CAG units, whose primary mission is to provide cost analysis support to the systems analyses conducted within the FCRC, CNA's CAG has a primary mission to conduct its own

¹See C. David Welmer, *The Application of Design-to-Cost Acquisition Policies to Selected Electronics Subsystem Development Programs*, Draft of IDA S-459, June 1975.

²This study is in response to the Congressional directive "...that \$2,000,000 of the total provided for JCS/OSD Technical Support be allocated to the Institute for Defense Analysis (sic) for an in-depth review of Air Defense Requirements." Report No. 94-517, 94th Congress, 1st sess., House, September 25, 1975, p. 27.

research on resource requirements. Only limited support is provided to cost-effectiveness studies. The planned research program for FY-76 involves tasks on:

MAN-YEARS

a. Methodology

Resource Models:

- (1) Relationship of Readiness and Materiel Support Costs
- (2) Aircraft Procurement Price Indices
- (3) Aircraft Maintenance Management
- (4) Military Personnel Management

} 7

TOTAL 7

b. Application

Support of Systems Analysis Studies:

- (1) Undersea Surveillance Systems
- (2) Tactical Nuclear Weapons
- (3) Ship Force Mix

} 3

TOTAL 3

GRAND TOTAL 10

The planned military research program for FY-76 of the four CAGs may be summarized in terms of man-years as follows:

Clients					FCRC	Area		
A	N	AF	OSD	TOTAL		Methodology	Application	Total
2	2	13		17	MITRE	7	10	17
		11	4	15	RAND	7	8	15
			13	13	IDA	6	7	13
	10			10	CNA	7	3	10
2	12	24	17	55	Total Man-Years	27	28	55
3	22	44	31	100	%	50	50	100

2. Current Climate in Which CAGs Operate

These CAGs find themselves in the same environment described in Section C.3. The direct impact of each of the

factors listed varies somewhat among the CAGs. In general, the impacts are as follows:

First, the Congressional ceiling prohibits the overall growth of the three Studies and Analyses FCRCs. MITRE's growth as a systems engineering FCRC is limited by the overall ceiling established for all FCRCs, i.e., MITRE grows at the expense of (say) Aerospace. Therefore, if a CAG wishes to expand its program in order to do more cost methodology research, it must generally do so at the expense of other organizations in the company. Further, the existence of the ceiling presents a severe problem for clients who wish to let tasks to CAGs (and to other units of an FCRC) once the ceiling has been allocated and the fiscal year underway. Many opportunities for studies and analyses work arise after (say) six or more months have gone by. By then there is no ceiling left unallocated and it is too late for the CAGs to help the manager who needs study support.

Second, existence of the Users Group impacts on the three S&A FCRCs to varying degrees. There is little or no impact at CNA or RAND-OSD (and not much more on RAND-AF) in that the Users Group has apparently delegated authority to the Presidents of CNA and RAND to assess the appropriateness of tasks and to allocate the ceiling. For example, the President of CNA has considerable freedom to allocate about 92 percent of the total CNA budget. IDA's Users Group has elected to play a much stronger role in the screening and approval of tasks and in the allocation of the ceiling. Thus, the IDA CAG clients must go through considerably more "red tape" (from their viewpoint) than those of RAND or CNA. The IDA CAG also finds itself in the delicate position of having to bargain with the Users Group for ceiling funds in competition with the major project management units of the company which, in turn, provide the substantive funding support of the CAG.

Third, the project management (or *tasking*) structure requires the CAGs to either obtain tasks directly for themselves or to provide support to the tasks of other units of the company. Functional cost analysis research by a CAG is severely limited (with the exception of CNA), as it must be done on the company's Independent Research and Development funds. Actually, it was pleasantly surprising to associate about 50 percent of the research program to methodology. In today's environment, a 50-50 split between methodology and application is as good as can be expected. Given the author's concern for building up our "capital" of methodology, it would be good to see a larger CAG research program with the increase going to unstructured functional research. Finally, the limited amount of Studies and Analyses money available to the DoD clients who sponsor Resource Analysis Studies makes it difficult for the CAG manager to increase his direct projects, as opposed to support of other projects.

E. SOME THOUGHTS ON THE FUTURE OF CAGs

The downward trend of CAG staffing appears to have leveled off. If so, then how can cost analysis in the DoD best benefit from the 50 to 60 cost analysts who will be available in the FCRC CAGs?

Obviously, the CAGs must continue to provide support to their company's systems analysis studies. That is an important and necessary function. Therefore, if the present requirement for support of studies continues, about half of the CAG staff will be available for research on cost analysis methodology (i.e., covering the development of concepts, models, data, or CERS)--the area where the CAGs best serve the community as a whole. Given that premise, two suggestions are presented for consideration. First, DoD should establish a special Cost Research Committee charged with the development of a

coordinated program of research on cost methodology.¹ Specific areas of research best suited to the FCRCs would be identified.²

The second suggestion perhaps borders on wishful thinking in today's environment. That is, some mechanism should be developed in DoD whereby the FCRC CAGs would be given a reasonable amount of funds to conduct research programs initiated entirely by themselves. Such functional research programs would be funded as a level-of-effort over several years. Such programs might foster development of new methodologies not now envisaged; for example, two areas where some fresh thinking is urgently needed are Total Force Structure Cost Methodology, and Cost-Effectiveness Methodology for Tactical Forces. It was mentioned earlier that one of the contributions of the 1950-60 era was total force structure cost methodology. However, the methodology developed requires relatively large resources--10 to 20 analysts--and such resources are just not available today. Either the entire Air Staff, for example, is involved in an "exercise" to develop a force cost estimate, or we "fake it" by estimates, plus or minus, to some existing baseline. What is needed to aid decision-makers in a credible, rapid methodology, using only a few analysts, that would estimate the time-phased LCC costs of a total force for (say) the next 15 years. No such methodology exists now.

The second area in need of fresh methodology is Cost-Effectiveness Studies for Tactical Systems. Systems analysts

¹There really isn't any DoD Cost Research Program. Recognition is given to the need for such a program at the annual DoD Cost Analysis Symposium but no effective mechanism exists to put it into effect. The military CAGs at all levels are hard-pressed to meet daily operations needs. For example, PA&E, which plays a lead role in the CAIG, has available 9 to 12 cost analysts who must cover 50 to 60 major systems and perhaps 30 DSARCs [formal reviews of program milestones by the Defense Systems Acquisition Review Council] (see DoD Directive 5000.1, July 13, 1971) per year, and do other things as well. No doubt, an excellent job is done, but such work levels leave little time to develop DoD-wide cost research programs.

²DoD CAGs are well-qualified to do cost research, however, they are "on the firing line" and are heavily workloaded.

for tactical weapons typically are best able to model the effectiveness of a weapon against a single type of target, for example, a tactical aircraft launching a missile against a tank. This one-on-one analysis is well-suited for the effectiveness analysis, but it is difficult, if not impossible, to allocate costs to this level in a meaningful way. On the other hand, cost analysts are best able to estimate the cost of a total force (or, at best, estimate at the level of an organizational unit such as a squadron). At this organizational level, tactical weapons generally have multiple mission capability (and repeat capability of a given mission). Effectiveness analysts find it difficult to measure the overall effectiveness of such forces (there are so many possible combinations of targets, defenses, weather, etc., affecting effectiveness.)¹ A joint cost-effectiveness methodology research program is needed to "bridge the gap."

The DoD has a valuable resource in the FCRC CAGs. We in the DoD cost analysis community must work together to ensure the best possible contribution of that resource in the years ahead.

¹For an elaboration on the problems involved in measuring the effectiveness of tactical forces, see J. A. Stockfish, *Models, Data, and War: A Critique of the Study of Conventional Forces*, The RAND Corporation, R-1526-PR, March 1975.